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CDC's National Health and Nutrition Examination Survey (NHANES)

The National Health and Nutrition Examination Surveys (NHANES) are a series of surveys designed to collect data on the health and nutritional status of the U.S. population. NHANES is unique in its ability to examine public health issues that can best be addressed through physical and laboratory examinations of the U.S. population. NHANES collects information about a wide range of topics, from the prevalence of infectious diseases to risk factors for cardiovascular disease. Beginning in 1999, NHANES became a continuous and annual survey. The sampling plan for each year follows a complex, stratified, multistage, probability cluster design to select a representative sample of the noninstitutionalized, civilian U.S. population.

The current sample design includes oversampling of African Americans, Mexican Americans, adolescents (aged 12-19 years), older Americans (aged 60 years or older), and pregnant women to produce more reliable estimates for these groups. The NHANES protocol includes a home interview followed by a standardized physical examination in a mobile examination center.

As part of the examination protocol, blood is obtained by venipuncture for participants aged 1 year and older, and urine specimens are collected for people aged 6 years and older. The 1999 NHANES was conducted in 12 counties across the United States. From these locations, 5,325 people were selected to participate in the survey. Of these, 3,812 (71 percent) participated in the examination component.

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Environmental chemicals were measured either in blood or urine specimens collected as part of the examination component. The age range for which a chemical was measured varied. Because of the availability of samples and the speed of analytical measurements, some environmental chemicals (metals, phthalate

metabolites, and organophosphate pesticide metabolites) were measured only in randomly selected subsamples within specific age groups.

Blood lead and cadmium were measured in all people aged 1 year and older. Serum cotinine was measured in all people aged 3 years and older. Blood mercury was measured in children aged 1-5 years and in women 16-49 years of age. Urine measurements for metals and phthalates were conducted for random one-third samples of people aged 6 years and older. Urine organophosphate metabolites were measured in a random one-half sample of children aged 6 through 11 years and in a random one-quarter sample of people aged 12-59 years. Age groups and sample sizes for each exposure measurement are shown in the data tables.
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NHANES data analysis

Because the NHANES sample design is complex, sample weights must be used to account for the unequal probability of selection into the survey. Sample weights are also used to adjust for possible bias resulting from nonresponse and are post-stratified to Census Bureau estimates of the U.S. population. All data analyses were conducted at the National Center for Health Statistics using the statistical software package, WESVAR, which uses sample weights and calculates variance estimates that account for the complex survey design. Selected percentiles and geometric means of analyte concentrations are presented. For each estimate, 95% confidence intervals are shown. Results are shown for the total population. For analytes that were measured in the full sample of people, results are also shown by age, sex, and race/ethnicity.

For these analyses, race/ethnicity is categorized as non-Hispanic black, Mexican American, and all others (most are non-Hispanic white). Analyte concentration levels less than the limit of detection were assigned a value equal to the detection limit divided by the square root of 2 for calculation of geometric mean values. Geometric means are calculated by first taking the log of each concentration, then calculating the mean of those log values, and finally taking the antilog of that mean (the calculation can be done using log base e or log base 10).

Geometric means were not calculated if the proportion of results below the limit of detection was greater than 40%. For urine measures, the Report shows data for both the concentration in urine and the concentration corrected for urine creatinine level. Creatinine-corrected values for results below the limit of detection were calculated only if the proportion of results below the limit of detection was less than 10%. In those cases, the fill value used to calculate geometric means was used in the calculation.

Limitations regarding estimates of chemical exposures from one year of NHANES.

Although the current NHANES is conducted using annual samples that are nationally representative, the sample size in any one year is relatively small, resulting in large variability for estimates,

especially those for detailed demographic groups or other detailed analyses. The NHANES is designed to increase precision by combining data across calendar years. Because of the small sample size in 1999, a number of survey participants have large sample weights, and the potential exists that these sample weights may strongly influence estimates. This is particularly important for chemical results that were only measured in subsamples.

Another analytic limitation of the NHANES sample is that it is selected from a relatively small number of sampling units (PSUs) or counties; the 1999 sample was planned for only 12 PSUs. With a small number of PSUs, variance estimates that account for the complex design will be relatively unstable, a factor which introduces a higher level of uncertainty in the annual estimates. Although the annual NHANES is nationally representative, it is not possible to produce environmental exposure estimates by geographic region. Because the number of geographic sites sampled each year is small and because environmental exposure measures may vary geographically, national estimates of these exposures, particularly based on 1 year of data, may be highly variable.

These limitations related to measuring environmental exposures from a single year of NHANES will be addressed as more data become available from the ongoing survey. More detailed analyses by demographic groups and other variables will be possible with increased sample size and with a larger number of geographic locations.

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Future data sources

Future releases of the Report will contain data from CDC exposure surveys, some of which will target the general population and some of which will target special-exposure groups. Future releases will also include data from CDC studies of human exposure and health effects, such as a study of human health effects associated with eating mercury-contaminated fish.

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